



HARVARD Kennedy School
BELFER CENTER
FOR SCIENCE AND INTERNATIONAL AFFAIRS
Managing the Atom Project

Geopolitical Trends: Growing Nuclear Dangers

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1

Effect of a single nuclear weapon

2



Source: Time-Life

2

Cuban Missile Crisis: The tale of sub B-59

3

- ❑ Diesel sub, designed for northern waters, not the Caribbean
 - >110° on board – carbon dioxide high, sailors passing out
- ❑ Sub armed with a nuclear torpedo – physical capability to fire
 - U.S. Navy did not know it was nuclear-armed
- ❑ U.S. Navy using “practice depth charges” to force it to the surface
 - Those on sub believe war has begun, they are under attack
- ❑ Captain orders nuclear torpedo prepared for firing, point toward the *USS Cony*, surfaces for air
- ❑ US aircraft firing tracer rounds, dropping flash explosives – captain panics, orders sub to submerge, prepare to fire
- ❑ *USS Cony* signals apology – and another captain aboard happens to see the signal because people got stuck going below

The fog of crisis can lead to disaster

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Some good news about nuclear weapons

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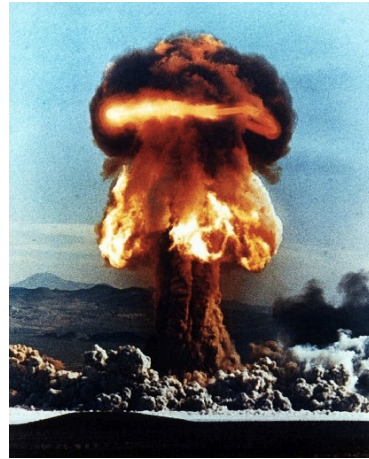
- ❑ ~80% of the world’s nuclear weapons have been dismantled
- ❑ Only 9 states with nuclear weapons – same as 30 years ago
 - No net increase in 3 turbulent decades – amazing success
- ❑ >50% of the states that started nuclear weapons programs gave them up
 - Efforts to prevent proliferation succeed more often than they fail
- ❑ >50% of the states that once had potential nuclear bomb material on their soil have eliminated it
- ❑ Nuclear material around the world is far more secure than it was 25 years ago
 - Most egregious weaknesses fixed – but more to be done

4

How might a nuclear war start?

5

- ❑ Nuclear deterrence makes a rational decision to begin a nuclear war hard to imagine...
- ❑ But Cold War crises, and pre-nuclear wars, highlight the dangers of unintended escalation, miscalculation in the heat of the moment, accidents, unauthorized use, decisions based on wrong information...
- ❑ Is nuclear conflict very likely, almost impossible, or somewhere in between?



Source: Department of Energy

5

Evolving technologies may be reducing deterrent stability

6

- ❑ BMD, cyber, counter-space, precision conventional, autonomy create new complexities → greater escalation risks
 - Cyber blurs lines between peace and conflict, difficult to control
 - Counter-space and cyber may both create incentives to hit first, early
 - Missile defenses complicate strategic planning
 - “Entanglement” of nuclear and conventional forces, command and control create incentives to escalate
 - AI-enabled decisions may shorten decision time



Hypersonic weapon concept. Source: space.com

6

Dateline: Russia

7

- ❑ Aggressive nuclear doctrine, modernization, novel weapons, exercises, rhetoric; cyberattacks; election interference...
- ❑ Heightened U.S.-Russian tensions – Ukraine, elections, other issues
 - Potential for conflict, e.g., in Baltics
- ❑ Russian forces, command and control vulnerable; arms control in crisis; potential for launch on false alarm or unintended crisis escalation



Source: ITAR-TASS

7

One U.S.-Russian nuclear arms control agreement left – what's next?

8

- ❑ ABM Treaty, INF Treaty, both terminated
- ❑ Presidents Biden and Putin extended New START for 5 years – but what comes then?
- ❑ New START is working
 - Both sides have met key limits
 - Inspections are almost the only remaining nuclear cooperation
 - Expires 2/2026
- ❑ Intense U.S.-Russian hostility, Russian INF Treaty violations, make it very difficult to reach, ratify new treaty
- ❑ What about China? What about non-strategic nuclear weapons? What about missile defenses, counter-space weaponry, other factors affecting strategic stability?

8

Why should we care?

Benefits of U.S.-Russian arms control

9

- ❑ Benefits of the agreements themselves:
 - Reduced mutual perceptions of threat
 - Force structure stability
 - Predictability (important for planning)
 - Transparency
 - Reduced cost of maintaining forces
- ❑ Benefits of the arms control process:
 - Discussions allow greater mutual understanding of nuclear policies, plans, perceived dangers
 - Build relationships, habits of cooperation that spill over to other areas
 - Offers arena in which Russia is treated as an equal – helps assuage prestige, humiliation concerns

9

From Putin's perspective: next steps in arms control

10

- ❑ Imagine: it's 2022, talks on a new arms control agreement are underway
- ❑ The U.S. wants
 - Significantly lower numbers
 - An accord that limits all warheads – including Russian tactical weapons
 - On-site inspections at warhead sites
 - Inclusion of new Russian weapon types in the treaty's limits
 - But the U.S. refuses any serious limits on missile defenses (including space-based ones) or precision conventional strike capabilities
- ❑ Should Russia agree?



Source: kremlin.ru

10

Dateline: China

11

- ❑ Much smaller nuclear force, but major modernization underway
 - ~300 weapons; DIA projects may double over 5 years
- ❑ U.S.-China tensions – trade, South and East China seas, cyber, other issues
- ❑ No arms control, verification, or dialogue on strategic issues in place
 - China (and Russia) concerned over U.S. missile defenses, conventional strike capabilities, nuclear modernization



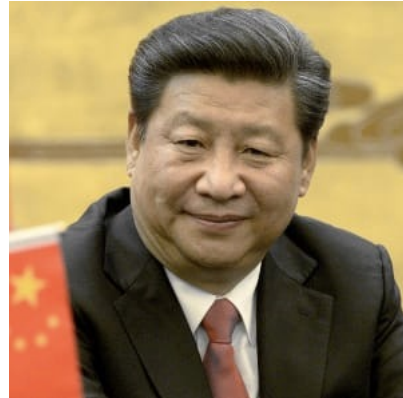
Source: AP, Li Gang

11

From Xi's perspective: participate in arms control?

12

- ❑ Imagine: it's 2022
- ❑ The U.S., concerned about China's growing (but still small) arsenal, wants China to agree to limits
 - China doesn't want to be formally locked into an inferior position
 - But China wants to be seen as an advocate of disarmament
 - U.S. is unwilling to constrain missile defenses that China sees as threatening its deterrent
- ❑ What limits, if any, should China agree to?
 - Formal, informal possibilities



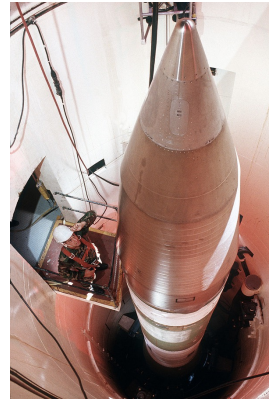
Source: Muneyoshi Someya/Getty Images

12

Dateline: United States Strategic modernization

13

- ❑ U.S. strategic weapons are aging
- ❑ Obama administration laid out a plan for new ICBMs, SLBMs, submarines, bombers, and cruise missiles, with “life extended” (upgraded) warheads
- ❑ Trump endorsed, expanded with new low-yield SLBM, nuclear SLCM, new warhead – Biden budget continues
- ❑ >\$1 trillion cost over 30 years
- ❑ Need broader debate over deterrence needs, costs, risks, arms control



Source: DOD

13

Dateline: North Korea

14

- ❑ Unpredictable dictator armed with ~40-60 nuclear weapons, ballistic missiles
 - Has threatened to rain “nuclear fire” on ROK, Japan, United States
- ❑ No recent nuclear or ICBM testing, but HEU, Pu production unabated
- ❑ History of provocations against ROK – could lead to conflict
- ❑ Agreements, sanctions, threats have all failed
- ❑ No clear prospects for “denuclearization”



Source: KCNA

14

From Kim's perspective: A potential conflict scenario

15

- ❑ Imagine:
 - A major North Korean provocation
 - e.g., shelling an island again
 - South Korea insists on striking back harder, to reestablish deterrence
 - North Korea uses ~6 conventional missiles against a U.S. airbase
 - ROK, U.S., begin an air campaign to destroy the DPRK's missiles
- ❑ DPRK faces “use them or lose them” pressures
- ❑ Can they tell the air campaign is not intended as a prelude to an all-out regime-change attack?



Source: Reuters

15

Dateline: South Asia

16

- ❑ Ongoing nuclear arms race between Pakistan and India – who have fought 4 wars
- ❑ Military doctrines with unclear redlines; terrorists might provoke conflict; could lead to blundering into war
- ❑ Pakistan has world's fastest-growing nuclear arsenal, and some of the world's most capable terrorists
- ❑ Some modeling suggests even Indo-Pakistani nuclear war could cause “nuclear fall”



Source: Wikimedia Commons

16

The surprising success of nonproliferation

17

- ❑ No net increase in nuclear-armed states in 30 years
- ❑ All but 5 states are parties to the nuclear Nonproliferation Treaty (NPT)
 - Obligated not to get nuclear weapons, and to accept inspections
 - Many other accords, initiatives, support the overall regime
 - Never in human history has the most powerful weapon available to our species been so widely forsworn
- ❑ What explains success?
 - Most states realize they are better off if they and their neighbors don't have nuclear weapons
 - Treaty changes states' decision-making: Foreign Minister, Finance Minister now more likely to be at the table, and nuclear weapons advocates need to reverse a decision already made
 - NPT creates norms – easier to build coalitions against programs

17

But growing challenges to the global regime

18

- ❑ Many states unhappy with the NPT – failed treaty review in 2015, another may be coming
 - Just postponed again
- ❑ Ongoing challenges controlling sensitive technologies – new tech. such as additive manufacturing makes more difficult
- ❑ Possible spread of ostensibly civilian enrichment and reprocessing as nuclear energy grows and spreads – steps needed to reduce risks
- ❑ Ban Treaty manifests frictions



Source: AFP

18

Dateline: Iran

19

- ❑ Nuclear agreement reduced risk – but putting it back together not easy
- ❑ Even if all parties return to compliance, much of time the accord bought is gone
 - Most key restraints end by 2030
- ❑ Iran continues to support terrorist groups, undermine countries in the region, threaten Israel, test longer-range ballistic missiles – and has never given an honest declaration of its past nuclear weapons efforts
- ❑ Where next?



Source: khamenei.ir

19

The Iran nuclear archive



- ❑ 6 key conclusions:
 - Iran had focused program to produce, test nuclear weapons
 - Made more technical progress than had previously been known
 - Has ability to reconstitute
 - Much more foreign assistance than previously understood
 - Some facilities, activities went undetected
 - Issues will have to be addressed in future deals
- ❑ Many mysteries remain...

20

Iranian challenges for the Biden team

21

- ❑ Timelines of original agreement now shorter – doesn't address missiles, support for terrorists
- ❑ Israel, Gulf states strongly opposed to US returning to accord
- ❑ Iranian election this month will bring hard-liners to power – and the Supreme Leader is a hard-liner
- ❑ Credibility of U.S. promises destroyed in Iran – sanctions genuinely difficult to unwind
- ❑ Will recent killings (Fakhrizadeh, Suleimani), Iranian attacks, poison possibilities?



Mohsen Fakhrizadeh

Source: Office of the Supreme Leader, via AP

21

From Khamenei's perspective: what to agree to, for what price?

22

- ❑ Imagine: it's 2022, all sides have returned to the JCPOA
- ❑ U.S. is asking for changes to the JCPOA – longer timelines, limits on long-range missiles...
- ❑ U.S. is offering broader sanctions relief in return
- ❑ What should Iran be prepared to offer, for what concessions from the United States or others?
 - What would make U.S. promises credible to you this time?
 - Should you authorize a new deal?



Source: Anadolu Agency via Getty Images

22

The rest of the Middle East – and East Asia

23

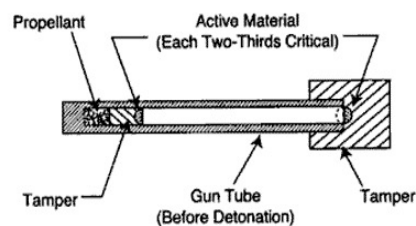
- ❑ Iran's program has given other countries in the region incentives to explore nuclear options
 - Saudi Arabia – statements threatening to get nuclear weapons if Iran does; ambitious civilian nuclear program; refusal to accept stronger inspections, or to rule out enrichment and reprocessing
 - Egypt – past safeguards violation never fully resolved; expanded civilian nuclear energy plans
 - Turkey – new statements calling NPT commitment into question, expanded civilian nuclear energy plans
- ❑ North Korea's program gives its neighbors incentives to worry – especially if extended deterrence weakened
 - Japan (full fuel cycle in place), ROK (majority support for nuclear weapons), Taiwan (faces growing threats, weaker U.S. commitment)
- ❑ Few apparent risks in other regions

23

Dateline: Unknown Nuclear and radiological terrorism

24

- ❑ Numerous gov't studies: terrorist group *could* plausibly make a crude bomb if it got material
- ❑ ~20 cases of seizure of stolen HEU or plutonium
- ❑ Aum Shinrikyo, al Qaeda both pursued nuclear weapons
- ❑ ISIS intent unclear, but had more money, people, territory under control, ability to recruit globally than al Qaeda ever had



Source: NATO

24

Dateline: Unknown

Nuclear and radiological terrorism (II)

25

- ❑ Terrorists could also sabotage nuclear facilities (potentially cause Fukushima-scale accident), or use radioactive material in “dirty bomb”
- ❑ Policy options
 - Improve security for nuclear and radiological materials, facilities (How to sustain momentum with the summit process years in the past?)
 - Block nuclear smuggling (How to find the needles in the haystacks?)
 - Counter high-capability terrorist groups (How can we do better?)
 - Prepare to respond (How much can this mitigate the harm?)

25

From Biden's perspective: what to prioritize?

26

- ❑ What should be his top priorities in reducing nuclear dangers?
 - Biggest risks to U.S., international security (probability x consequences)
 - Biggest opportunities to reduce risks
- ❑ Many possibilities:
 - U.S.-Russia
 - U.S.-China
 - North Korea
 - Iran
 - Nuclear terrorism
 - Global regime
 - U.S. forces, posture, doctrine, alliances
 - Other



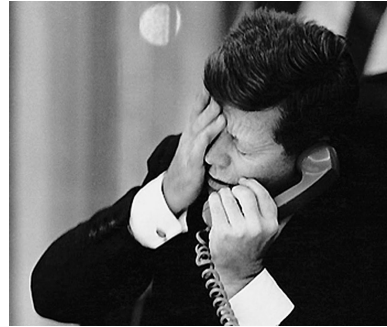
Source: Win McNamee/Getty Images

26

The importance of presidential judgment

27

- ❑ Cuban Missile Crisis:
 - Initially, Kennedy's advisors called for air strikes followed by an invasion
 - Kennedy pushed back, asking for another option
 - The recommended course might well have led to nuclear war
- ❑ Kennedy: Key lesson was always to offer the adversary a face-saving way to back down
- ❑ The world relies on sober judgment by the leaders of nuclear states



Source: JFK Library

27

Some key takeaways

28

- ❑ Nuclear weapons continue to pose real risks to U.S. and global security, requiring constant attention to minimize
- ❑ Evolving technologies may reduce deterrent stability – but likely to be more continuity than change
- ❑ U.S.-Russian nuclear arms control has had real benefits for U.S. and global security, and is worth trying to continue
- ❑ The global effort to stem the spread of nuclear weapons has been surprisingly successful, and serves almost everyone's interests
 - But requires constant effort for continued success
- ❑ Nuclear and radiological terrorism remain real dangers
- ❑ Good policy has managed to reduce nuclear dangers in multiple areas – and can do so again in the future

28

Further reading...

29

- ❑ “For Security’s Sake: Saving U.S.-Russian Arms Control,” presentation, Oak Ridge National Laboratory, 2018
<https://tinyurl.com/y5u4p7xh>
- ❑ *Revitalizing Nuclear Security in an Era of Uncertainty*, 2019
<https://www.belfercenter.org/NuclearSecurity2019>
- ❑ *Preventing Black-Market Trade in Nuclear Technology*, 2018
- ❑ *The Iran Nuclear Archive: Impressions and Implications*, 2019
- ❑ Full text of Managing the Atom publications:
<http://belfercenter.org/mta>
- ❑ Full text of Bunn publications and presentations, by topic:
https://scholar.harvard.edu/matthew_bunn

29

Back-up slides

30

30

Dateline: Global Chemical and biological threats

31

- ☐ Current pandemic shows the impact contagious disease can have
 - Imagine if more contagious, more deadly
- ☐ Widespread chemical use by Syria – even after alleged disarmament
- ☐ North Korea and Russia apparently used chemical weapons for assassinations—may indicate other stocks
- ☐ Terrorists have pursued chemical, biological weapons
 - ISIS produced, used its own mustard gas
 - Aum Shinrikyo conducted nerve gas attacks in Tokyo subways
 - Aum Shinrikyo, al Qaeda pursued anthrax, other biological agents
 - New gene editing technology (e.g., CRISPR) could increase risks
- ☐ Some state biological weapons programs may persist
- ☐ Deep dual-use dilemmas, verification challenges

31

Group assignment: allocate effort to reduce nuclear risks

32

- ☐ What percent of total nuclear risk reduction effort (high-level political attention, \$, other resources) should be allocated to reducing risks posed by:
 - U.S.-Russian conflict
 - U.S.-China conflict
 - North Korea
 - Iran
 - South Asia conflict
 - Nuclear/radiological terrorists
 - Other?
- ☐ Base allocations on:
 - Scale of risk to U.S. or global security (probability x consequences)
 - Degree to which U.S. or global policies could reduce the risk

32

A risk-informed approach

33

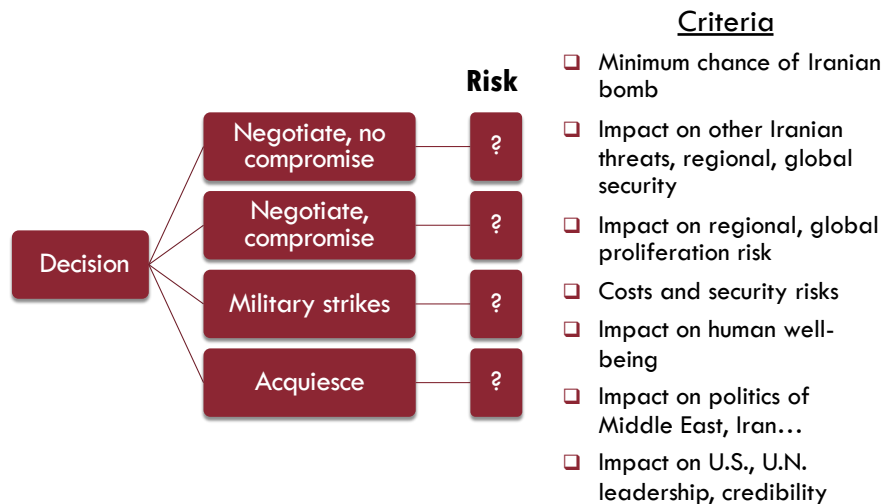
- ❑ Risk: probability x consequences
- ❑ What's the problem?
 - Identify, prioritize, risks and objectives
- ❑ What are the options to address it?
 - Start with broad categories – get specific later
- ❑ What are the plausible outcomes of each option?
 - Estimate probability, consequences of each outcome
- ❑ Choose the option that offers lowest risk/most benefit

In real life, these judgments are highly uncertain, debatable – but this approach offers a structure for thinking and choice

33

Iran: should Obama have cut a deal?

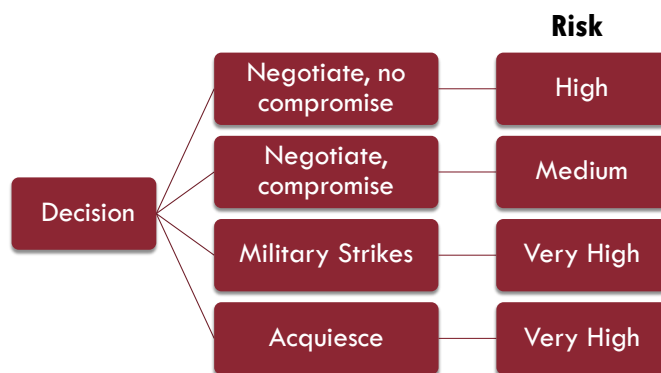
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34

Comparing the alternatives

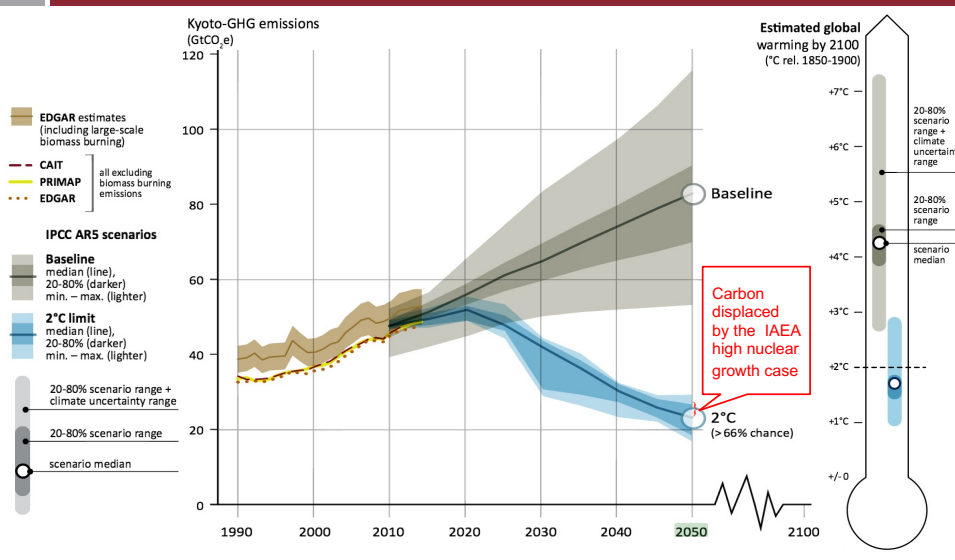
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35

Huge, transformational nuclear growth needed for substantial climate role

36



36

Particulates may be even more important than climate in driving clean energy

37



Smog in Beijing. Source: inhabitat.com

- ❑ **>3 million deaths/yr globally from fine particulates**

37

Key constraints on large-scale nuclear energy growth – can they be loosened?

38

- ❑ Economics
- ❑ Safety risks – real and perceived
- ❑ Security risks – real and perceived
- ❑ Nuclear waste management – mostly politics
- ❑ Siting and public acceptance
- ❑ Limited government and industry capacity
- ❑ Stringent regulation
- ❑ Proliferation risks – mainly from the nuclear fuel cycle
- ❑ U supply: Not likely to be a constraint this century

In each area, both new policies and new technologies have the potential to loosen past constraints on growth

38

Maintaining U.S. nuclear influence

39

- ❑ U.S. role in the nuclear market is now greatly reduced
- ❑ But the United States offers world-leading innovation, and approaches to safety, security, and nonproliferation
- ❑ Both economic and security benefits to maintaining a significant U.S. position in nuclear markets
 - Important to U.S. influence over other countries' nuclear choices
- ❑ Next president will have to grapple with:
 - How to avoid losing nuclear's domestic low-carbon contribution
 - How to ease the path to commercializing new technologies
 - How to help U.S. firms compete against state-owned (or assisted) firms from other countries
 - How best to advance U.S. nuclear safety, security, nonproliferation objectives